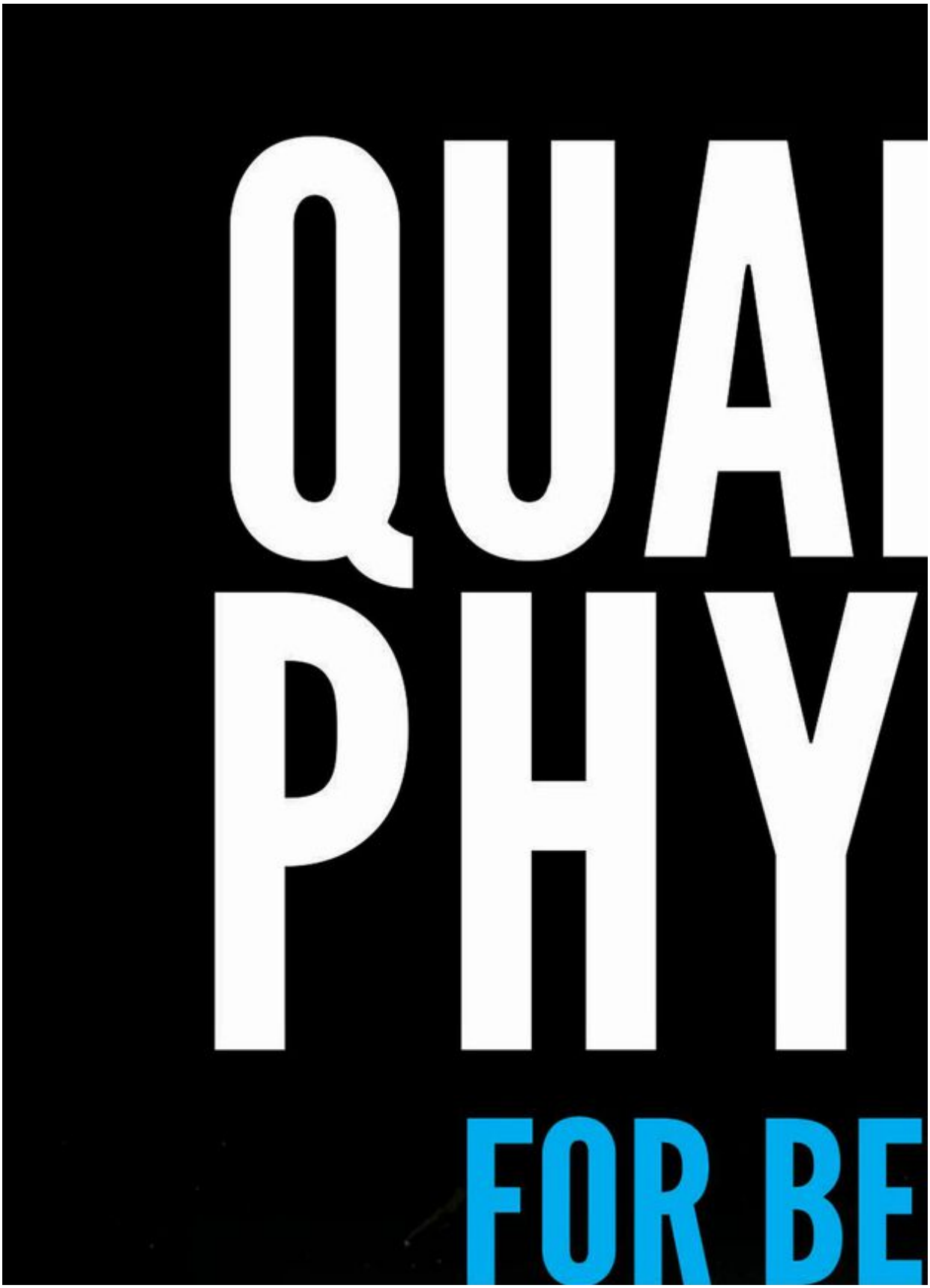
QUANTUM PHYSICS

FOR BEGINNERS

Mastering Quantum Physics and Theory of Relativity & Mechanics

Larry Haynes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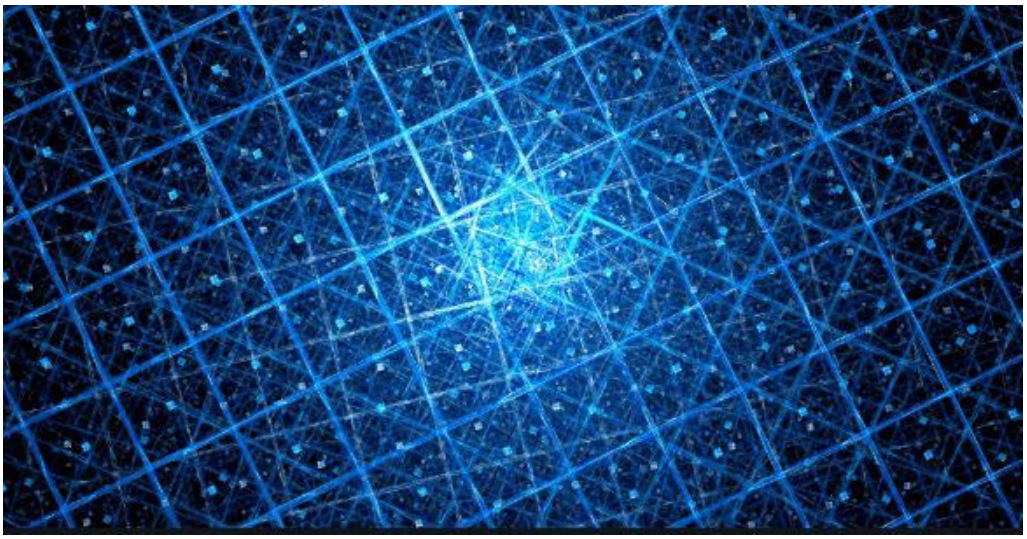


Quantum physics is known as a physical science that has a connection with how energy and matter work on the scale of subatomic, atomic waves, and particles.

Also, quantum physics creates the basis for the modern knowledge of how large objects like the galaxies and stars can be explained in simple terms.

This concept is the beginning of multiple related principles such as condensed matter physics, structural biology, quantum chemistry, nanotechnology, electronics, and particle physics.

Quantum Physics is a phrase that was originally formed by Max Born in 1924. The reason why everyone accepted this concept is because of its accurate and precise prediction of the physical behavior of systems, such as the kind of systems where Newtonian mechanics were not successful.

Quantum physics has proved to work right from the beginning after a century of applied science and experimentations had taken place. Furthermore, this concept can be dated back to the early 1800s; however, the major start of quantum physics comes from the work of Max Planck in 1900.

Also, Niels Bohr and Albert Einstein contributed to the concept, but their work is currently referred to as the old quantum physics.

The modern concept is a result of the astonishing works of the likes of Max Born, Erwin Schrodinger, Werner Heisenberg, and so many others.

There is a whole lot of knowledge to equip yourself with as regards to Quantum Physics, and they are all detailed in this book.

CHAPTER ONE

What is Quantum physics?

We cannot talk about Quantum Physics without having a look at what Quantum is all about. Well, Quantum is a Latin word, which means ‘how much.’

Quantum, in the real sense, means the separate units of energy and matter that are guessed by, studied and watched in quantum physics.

In addition, time and space, which are known to be infinite, do not have the largest values, rather it has the smallest values.

Quantum physics is the art of the behavior of energy and matter at the atomic, nuclear, molecular, and microscopic levels.

Things to know about Quantum physics

Quantum physics, according to many, is frightening and unapproachable from the start. It is a bit strange even for physicists who make use of it every single day.

If you decide to practice or go into Quantum physics, here are some things to know about this theory. They include:

1. Everything in the Universe is made of particles and waves

It is believed that everything in the Universe is made of particles and waves. There is no doubt that everything in the Universe has a particle nature. On the outside, it looks so strange and untrue, but it is something that is being tested in the laboratory.

Describing or labeling real objects as waves and particles is a bit inaccurate and indefinite. In simple terms, the objects labeled by Quantum physics are not waves or particles. However, a third aspect also contains some properties of waves, which are a part of wavelength and frequency and particles.

As a result, there are some question marks asked about physics education and if it is right to discuss light as a particle. This is not based on light having a bit of particle nature, but it is because of calling photons particles and not excitations of a quantum field.

Many people will not agree to this because many similar worries have been talked about calling electrons particles.

2. Quantum physics is probabilistic

The most worrisome and astonishing controversies surrounding quantum physics is that it is not possible to predict with assurance the result of one test on a quantum system.

Whenever physicists predict the result of a particular experiment, the expectation in question usually assumes the role of probability for discovering each of the possible results.

There is also a comparison between the test and the theory. The comparison will most certainly have something to do with probability distributions from different repeated tests.

Furthermore, the mathematical explanation of quantum physics is usually in the form of a wave function. This has sparked numerous conversations between various people and physicists in particular.

The conversation is always based on what the wave function represents, and it is divided into two concepts. One of the concepts is those that believe that

wave function is a physical and real thing, while the other concept is those sets of people that believe that wave function is just an expression of our understanding.

Both concepts have established that the probability of locating a result is not based on the wave function, but simply by the square of the wave function.

The wave function is a difficult mathematical object, which means there are imaginary numbers such as the square root of a negative one.

This part of the theory also suggests that particles that are in several states simultaneously. The basic point that we can all assume is a probability. Before a measurement shows an exact result, the system that is measured is not being able to be determined.

It does not matter if you believe that the systems are in different states simultaneously or not; it only depends on your thought about ontic versus epistemic models.

3. Quantum physics is discrete

This point is simply related to the name “Quantum,” which is represented by the English meaning, “how much.” In turn, this means that quantum models are often related to things that have discrete amounts.

The energy which is found in quantum fields is a result of integer multiples of a few basic energy. When it comes to light, it is often linked with the wavelength and frequency of the light.

In simple terms, high frequency and short-wavelength light is filled with large characteristic energy, while low frequency and long wavelength light contain lower characteristic energy.

Although all the energy in one light field is an integer multiple of that energy, it is still not a strange fraction.

Also, this same instance is found in the discrete energy bands of solids and atoms. While some values of energy are permitted, other values are not granted access.

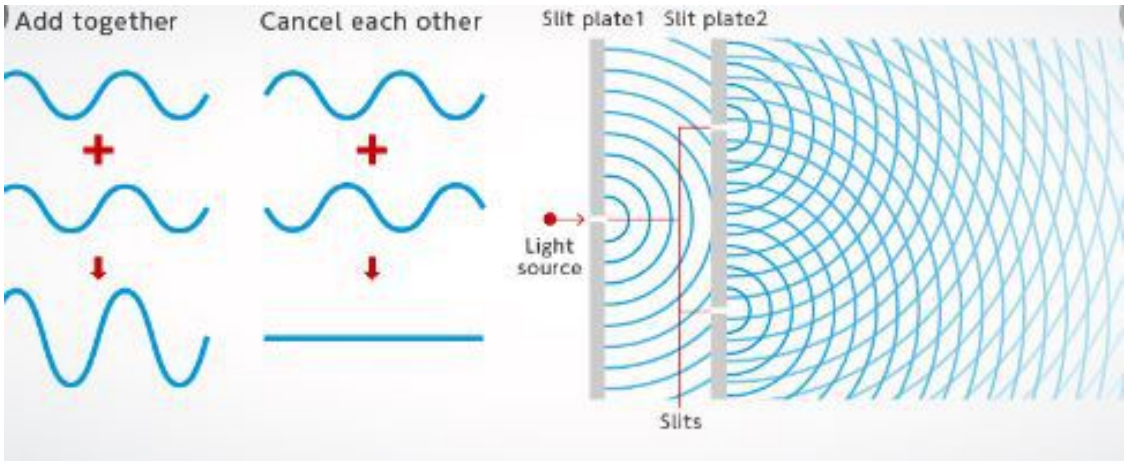
The effectiveness of atomic clocks is also brought here due to the discreteness of quantum physics with the use of the frequency of light that is related to a transition between 2 permitted states in cesium.

You can as well make use of ultra-precise spectroscopy for certain operations such as dark matter.

CHAPTER TWO

Quantum physics concepts

Wave-particle duality/dualism



The wave nature of light elucidates a major part of its properties. These properties include the following:

- Doppler effect
- Refraction and reflection effect and,
- Interference and diffraction effect

However, the outcomes from spectroscopy, which includes absorption and emission spectra, can be explained assuming light has a particle nature as displayed and explained by the photon labeling of light by Bohr's atom.

Also, this type of effect sees a weak UV light producing a current addition of photoelectric effect. The duality to the nature of light is explained and best illustrated by the flow and releases electron. On the other hand, a strong red light fails to release electrons, even if the red light shows very well.

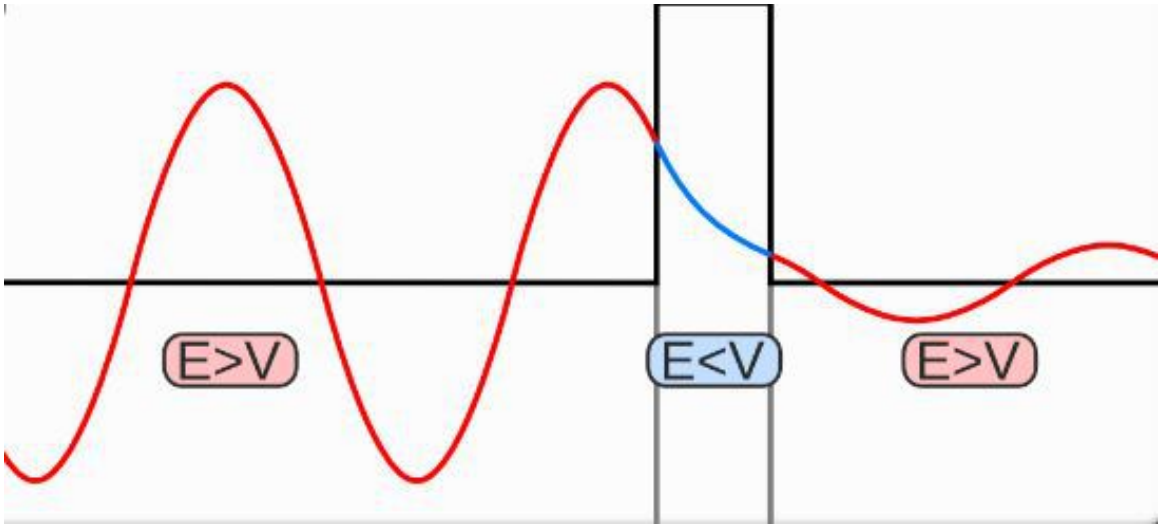
Albert Einstein further emphasized that light exists in a particle-like state because packets of energy are also photons. Furthermore, the photoelectric effect happens because the packets of energy taken per red photons are not strong enough to push the electrons off the atoms ***(NB: It will still be***

unable to push the electrons off the atoms, even if there were many red photons you beam on the cathode) .

Also, individual UV photon, which is not in a group, is powerful enough to release the electron and lead to a current flow.

It is a very weird but an ultimate concept in the physics world of today. The weird but fundamental concept means that light has both a particle and wave state, but it does not occur simultaneously, and it is also referred to as wave-particle duality or dualism.

Quantum Tunneling



Quantum tunneling means the non-zero chance that a particle in quantum physics can be measured to be placed in a state that is not allowed in classical physics.

Furthermore, quantum tunneling happens because there is the existence of a non-trivial solution to the Schrodinger equation in a classically not permitted area, which agrees and matches the exponential decay of the magnitude of the wavefunction.

To demonstrate the idea of quantum tunneling, imagine attempting to place an electron in a box. You could attempt to pin down the position of the particle by shrinking the walls of the box, and the outcome will be that the

electron wavefunction will get a higher momentum uncertainty by the Heisenberg uncertainty standard.

While the box depreciates in size, the chance of measuring the position of the electron to be away from the box goes higher and higher towards a single electron. This is even carried out while the electron is placed inside the box.

Meanwhile, the simplest solvable instance of quantum tunneling is in a single dimension. On the other hand, quantum tunneling is the cause for numerous physical phenomena in 3 dimensions, like scanning tunneling microscopy, radioactive decay, and the behavior of semiconductors and superconductors.

Superposition

Superposition is a fundamental idea of quantum physics. In basic terms, superposition means that any two quantum states can be joined together, and the outcome will be a new effective quantum state.

In addition, it also states that every quantum state can be given as a total of two and more other distinct states.

Based on Maths, superposition is explained based on a property of outcomes to the Schrodinger equation. This is because the Schrodinger equation is linear.

The idea of superposition states that assuming a physical system might be in multiple configurations, particles, fields, or arrangements, then the highest universal state is a joint effort of all the chances, whereby a difficult number reveals the amount in every configuration.

Meanwhile, the non-classical nature of the superposition procedures is clear if we look at the superposition of two states, namely A & B.

This explanation can be made easy when we assume there is an observation, and if it is done on the system in state A, it will result in a certain outcome, while if done in state B, it will lead to a whole different outcome.

CHAPTER THREE

History of Quantum physics

The history of quantum physics is a very important aspect of the new physics. Before we get started, it is essential to know that quantum physics history is also linked with the history of quantum chemistry.

They both began with several multiple scientific findings. For instance, the cathode rays discovered by Michael Faraday in 1838, the discovery of black-body radiation by Gustav Kirchhoff in 1859 and 1860, the recommendation that states that energy states of a physical system can be discrete by Ludwig Boltzmann in 1877 and a host of others.

Quantum physics was coined in Germany by a team of physicists, including Wolfgang Pauli, Werner Heisenberg, and Max Born. It was done at the University of Gottingen at the beginning of 1920.

While everything started with Max Born's theory, others gradually picked up, and they were all applied to bonding, chemical structure, and reactivity.

Most importantly, Max Planck and Niels Bohr were the original founders of quantum physics. They were recognized when they bagged a Nobel Prize in Physics, specifically for their effort on quanta.

At the closure of the 19^{th} century, the then scientists had formed added information about how light and matter act. However, it was nearly empirical because it was based on observations and not explanations on theory.

Nobody was aware of how spectral lines were created, and no human knows how light could pass through space as either a wave or a particle.

Subtle was the name for the nature of matter. Of course, nobody also understood why different elements have properties that show as periodic, and as well, no one understood the reasons for the formation of radiation and fluorescence.

Meanwhile, while we entered the 20^{th} century, it was revealed that all the above assumptions which were not able to be explained were all linked to

quantum physics, which was, at that time, a modern physical law that looked to be effective in the microscopic world.

As time went on, quantum physics revealed that even small objects act in a way that flouts and goes beyond common sense. In recent times, this has changed our knowledge of the world at large.

Even with its weirdness, the special predictions of quantum physics have never been a lie. Additionally, the theory was formally used to explain multiple principles, like the behavior of the subatomic particles.

Virtually every new technology has its hope on the laws of quantum physics to be effective, and this also includes lasers, transistors, and microchips.

Quantum physics has evolved since the time of Max Born, Bohr, Schrodinger, and others to what it really is today.

Is light a particle or a wave?

According to experts in physics, light can either be a particle or a wave. Here is how we arrived at the decision that light is either a particle or a wave.

- **Light as a wave**

Light can be labeled as an electromagnetic wave in that a changing electric field forms a changing magnetic field. In turn, the changing magnetic field further forms a changing electric field, and that is what is simply termed as light.

In contrast with a lot of other waves like water and sound waves, light does not require a medium to wave in.

- **Light as a particle**

Some scholars have come up with the notion that light is also a particle. Light can be seen as individual things, and this makes for particles.

In summary, is light a particle or a wave is one challenging question which answer is not definite. In some circumstances, light can act as a particle, while in other circumstances, light actually acts as a wave.

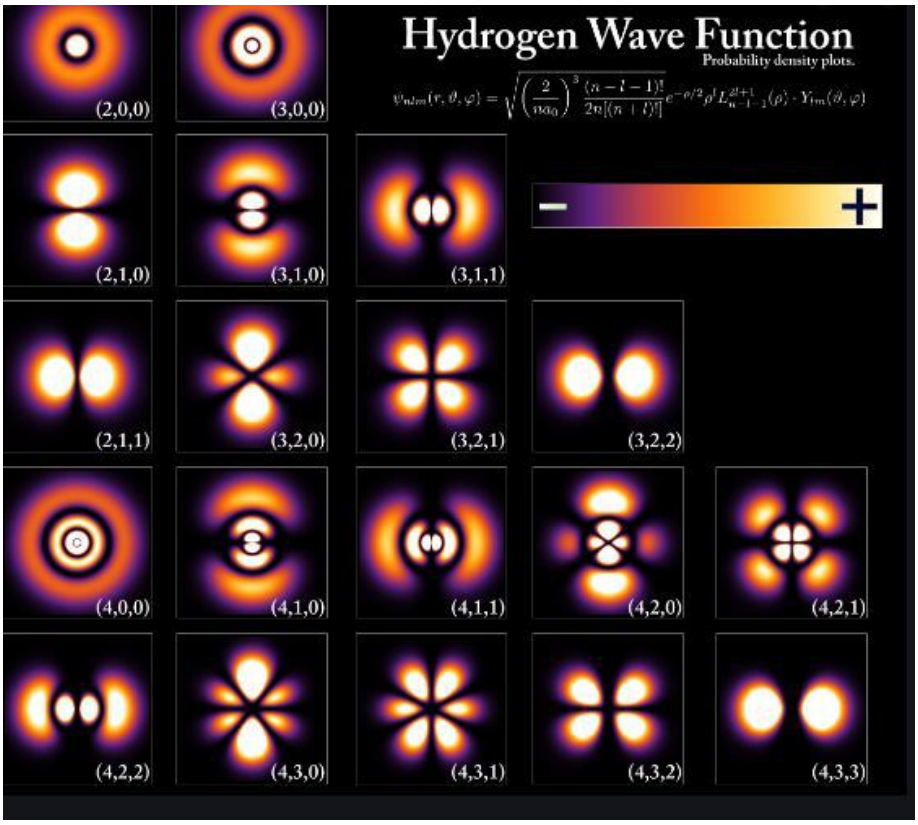
Meanwhile, some things may go wrong with the assumption that light is either a particle or a wave.

Here are some of the points that show that there is something wrong with both assumptions:

- **Gravity:** The model for gravitational force works when it is close to the surface of the planet earth.

- **Momentum:** This is another point that shows there is something wrong with light being either a particle or a wave. At lower speed, the model of non-relativistic and better momentum works together. However, if the proton goes way fast, both the better momentum and the non-relativistic model will not work out anymore.

What is a wave function?



A wave function is referred to as the function that shows the chance of a particle’s quantum state as a function of time, spin, momentum, or position.

As a matter of fact, wave functions are commonly known by the variable.

Furthermore, a wave function can be used to show the chance of discovering or locating an electron within a matter-wave. To carry this out, the wave function, which has an imaginary number, is always squared to produce a valid number solution.

Also, the chance of an electron staying within a particular position can then be checked. The wave function was brought into existence by a well-known scientist known as Erwin Schrodinger in 1925.

What’s more? Wave function carries vital information that concerns the electro and its link with the wave function and how we get the angular momentum, orbital orientation, and the electron’s energy.

Additionally, the wave function can either be negative or positive. The negative or positive sign is crucial when calculating. In fact, it is also vital

whenever the wave functions of two or more atoms join together to create a molecule.

The wave functions that have similar signs will interfere constructively, resulting in the chance of bonding. On the other hand, the wave functions that do not have similar signs will interfere destructively.

Due to Schrodinger’s equation, scientists were then suitable to know the wave functions for electrons in molecules and atoms.

CHAPTER FOUR

Do particles actually act like waves?

Here are some questions to ask before we arrive at a conclusion if particles actually act as waves. One of the questions is if electrons act like waves, it is possible for it to be diffracted?

The second question is, assuming we force a beam of electrons through 2 slits side-by-side, is it possible to see interference fringes on a far screen?

Additionally, the third question goes, assuming we reduce the intensity of the beam so that a single electron passes through the slits simultaneously. Then what happens?

At first sight, it is appealing to the eyes. Meanwhile, each electron that goes through the slits will always register as one spot on the screen. What this means is that one electron was present on the screen.

This same thing goes with the idea that electrons are particles, and it looks like they usually pass through one after the other, and it is done through one or another slit, and it makes a mark on the screen at different times.

Do not be quick to conclude because the pattern is not random. When a greater number of electrons pass through slits, then a threshold has been crossed. At this point, we will start seeing individual dots forming a group, then going before another, and joining together. In the end, we would arrive at a two-slit interference pattern of changing dark and bring fringes.

Also, we can conclude that the wave behavior of the electron is intrinsic.

Based on the wave function, every individual electron acts as a wave, while going through both slits at the same time and interfering with one another prior to hitting the screen.

Is it possible for a particle to be in two places simultaneously?

At one point in time, a physics scholar identified as Schrodinger formally drove to interpret the wave function in simple terms, like the theoretical

explanation of a matter-wave.

Also, Max Born in 1962, suggested that for one-electron interference, there must be a gap breached with another interpretation.

Max Born further went on to reveal that in quantum physics, the wave function squared is known as a measure of the probability of locating its related electron in one area.

The holders and changing peaks of the electron wave translate into a pattern of quantum probabilities. In the bright fringe, there is known to be a much better probability of discovering the subsequent electron.

However, when it comes to the dark fringe, the reverse is the case because there is known to be a much lower probability of discovering the subsequent electron.

Before an electron hits the screen, there is always a chance that it would be found anywhere, as far as the square of the wave function is greater than 0 (Zero).

The chance of numerous states existing simultaneously is referred to as quantum superposition. Consequently, this does not stake the claim that one electron can stay in multiple places at the same time.

On the other hand, there is no hiding the fact that it has a chance of being seen in multiple places simultaneously. To interpret this wave function to be the physical thing, it makes more meaning when it is shared.

When it comes to one electron at a time, we mean an electron like a particle. In other sense, it will not exist until the wave function has a link or connection with the screen. Once it finally has a link, it will collapse, while the electron will show at a single place.

Why is probability necessary in Quantum physics?

Before we get started, we must bring an equation to this topic. When a coin is tossed, a 50% chance that the tossed coin will land with heads. This means that the tossed coin has two sides, and there is no way to find out which of the ways it will end up.

By this equation, it is safe to say that it is a classical probability that came out due to ignorance.

Also, we can be sure that the coin will have two sides, namely heads and tails.

CHAPTER FIVE

What is the distance from a nucleus to an electron?

Bohr radius has estimated the likely distance between the protons in the electrons and nucleus. In contrast, electrons are not solid enough.

In basic terms, the distance from a nucleus to an election is about one-twentieth of a nanometer. On the other hand, this distance can only make sense if the electron was to be a solid particle.

Quantum physics reveals that, as humans, we are only allowed to talk about an electron's orbital position statistically. Other than that, we are not permitted to discuss an electron's orbital position.

Meanwhile, discussing the electron's wave function provides us with a measure of that probability. It also has a value illogically near the nucleus and the other part of the galaxy.

Difference between Quantum Physics and Classical Physics

Quantum physics is a theory in physics that shows the physical properties of nature at small scales. It also has a link with subatomic particles and atoms.

Whereas, classical physics is the description of physics that was in existence prior to the quantum physics theory and the relativity theory. It shows several parts of nature at a macroscopic scale. Meanwhile, quantum physics shows the parts of nature at subatomic and atomic scales.

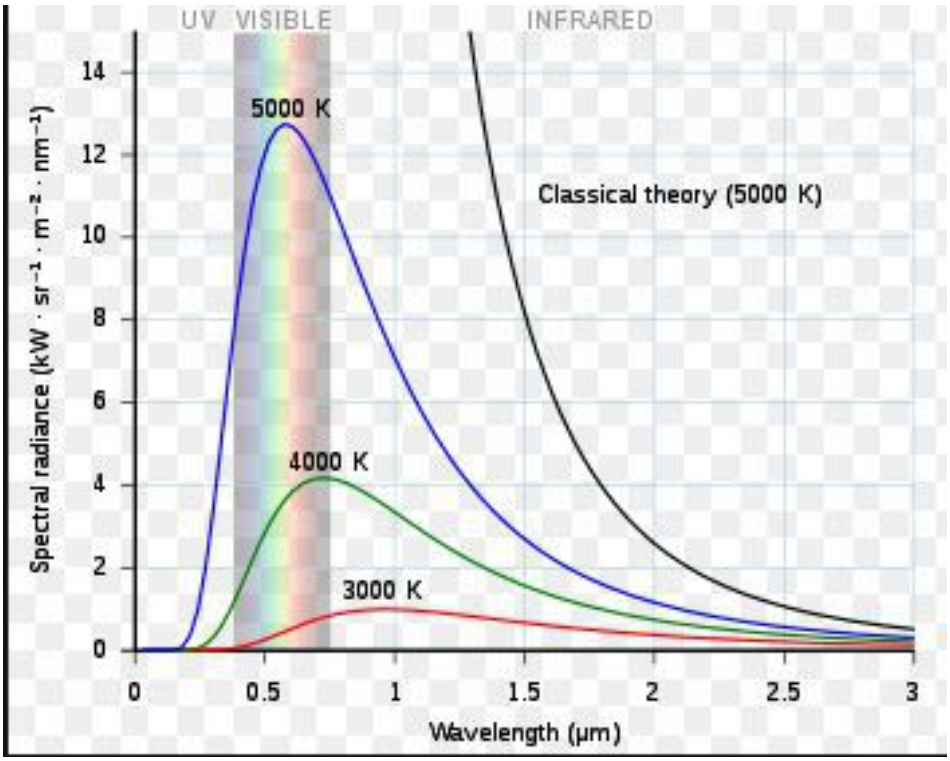
Almost all the theories in classical physics can be gotten from quantum physics as an approximation valid at a macroscopic scale.

Quantum physics is different from classic physics because angular momentum, energy, momentum, and so on are limited to discrete values. In quantum physics, objects are filled with waves and particles.

CHAPTER SIX

More Quantum physics concepts

Planck's constant



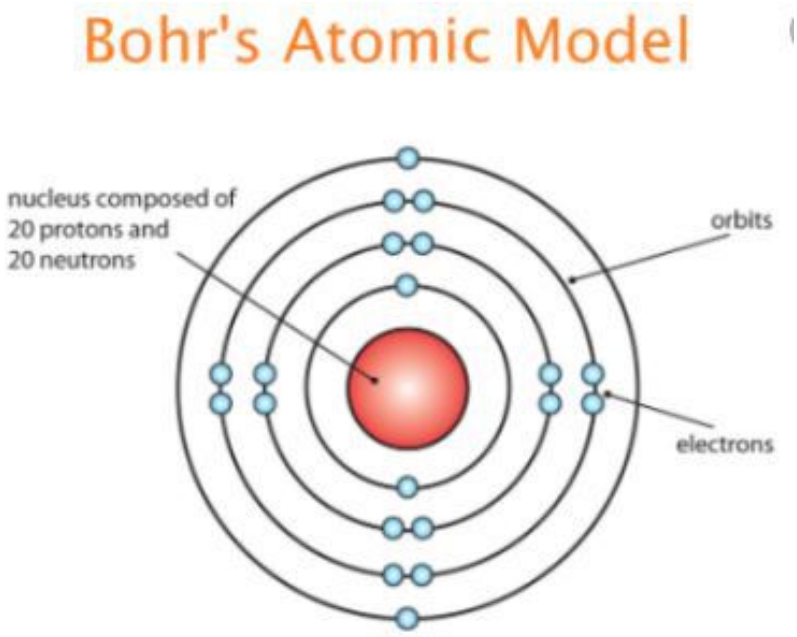
In the beginning, when there was still intense investigation to discover the things that form atoms, a well-renowned physicist known as Max Planck discovered a logical issue for the structure of the atom.

In simple terms, Max Planck discovered a fatal error in physics. He did this by showing that the electron in the circle around the nucleus accelerates.

Acceleration in this term simply means an alteration in the electric field ***(NB: This is because the electron has to charge)*** .

In addition, photons are expected to be released. On the other hand, the electron will go into the nucleus when it loses energy. Hence, atoms should not be in existence.

Bohr atom



In the 20th century, the leading scientist was Niels Bohr. He was also the first scientist to apply Planck's quantum idea to certain issues that were put to the table in atomic physics.

Additionally, while in the early 1900s, Niels Bohr projected a description in quantum physics of the atom to cover up for the early version of the one released by Rutherford.

Bohr's version gave discrete orbits for the electron, which was several of Planck's constant, and not permitting a range of energies as permitted by the former classical physics.

(Image of Neil Bohr)

The effectiveness of Bohr’s atom version cannot be underestimated. His version was able to predict the spectra of light released by atoms. His version was also able to explain and illustrate the spectral lines of atoms as the emission and absorption of photons by the electrons in quantized circuits.

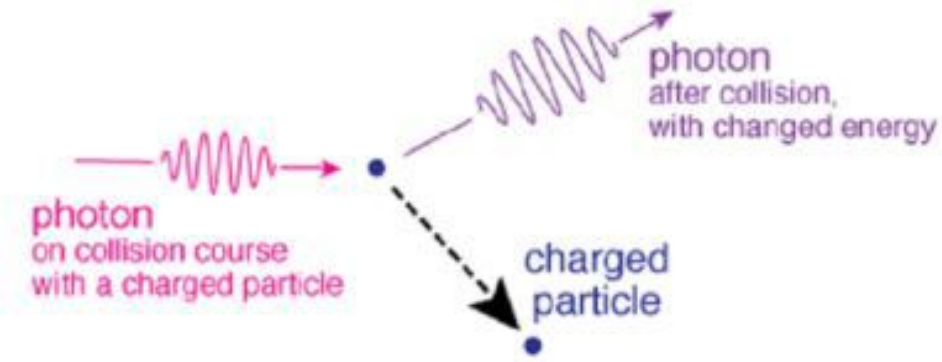
Meanwhile, our present knowledge of the atomic structure was dignified by Schroedinger and Heisenberg in the mid-1920s. Around that time, the discreteness of the permitted energy states came from a universal part, and it was not forced like the one in Niels Bohr’s version.

Both Schroedinger and Heisenberg's version of quantum physics has constant and reliable basic philosophies, like the incorporation of the uncertainty philosophies and the wave character of matter.

All the molecular and atomic physics, like the dynamics and structure of atoms, the chemical behavior, and the periodic table of elements and the physical, electrical, and spectroscopic properties of molecules and atoms, can be accounted for by quantum physics.

CHAPTER SEVEN

De Broglie Matter Waves



(Image of De Broglie matter waves)

One of the most crucial questions that came up when Bohr introduced quantized orbits is that, why does an electron go with quantized orbits?

The answer to the above question came from the Ph.D. thesis of Louis de Broglie in 1923. According to de Broglie, he debated that since light can show particle properties and wave, then maybe matter is not far from being a wave and particle as well.

(Image of Louis De Broglie)

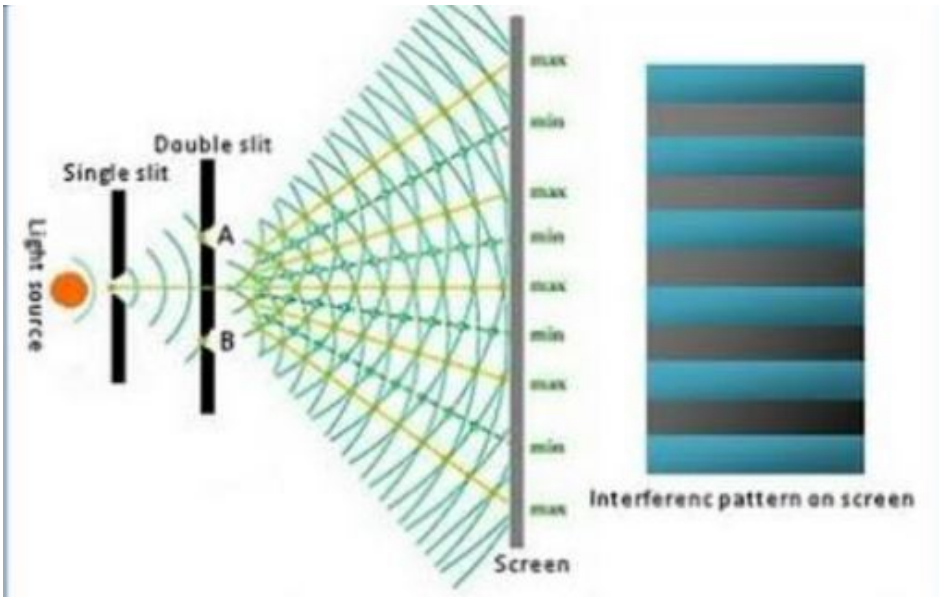
One of the methods to look at the matter is to imagine seeing a wave packet. A free-moving electron or photon can be seen as a wave packet, with both a single position and properties that look like a wave.

Meanwhile, a few and unbothered issues, like the wave packet, do not actually stop at a finite distance from its start. Besides, it does go on and on. After completing this, can we arrive at the decision that an electron can be found at all places in its path?

De Broglie further gave a much earlier formula that the wavelength of a matter particle is linked to the momentum of the particle. This means that energy is related to the wave property of matter.

The wave nature of the electron produces an elegant definition to quantized orbits that surround the atom.

Young Two-Slit Experiment



The properties of light, which has the looks of the wave, were illustrated by the well-known experiment carried out by Thomas Young at the beginning of the 19th century.

In the first experiment, which was carried out by Young, a point source of light irradiates two narrow adjacent slits in a screen. It also illuminates the light image that goes through the slits, and it is seen on another screen.

The light and dark areas are referred to as interference fringes of light waves ***(NB: They can also be called destructive and constructive interference of light waves)*** . The subsequent question that will arise is if the matter will be able to produce or make for interference patterns.

Well, the answer to the above question is Yes. ***(NB: It has been tested by shooting a stream of electrons)*** .

On the other hand, take note that electrons carry the form of particles, just like you have with photons. For instance, electrons produce one strike on a cathode ray tube screen. Thus, when we reduce the number of electrons in the beam to about one every second, will the interference patter fade?

Definitely No. Instead, we would see the single photons and electrons strike the screen, and simultaneously, the interference pattern will be built. ***(NB: While having a slow pace, every photon will not be in contact with other photons to make the interference pattern)*** .

Meanwhile, the photons are in communication with each other in their different wave packets, making for interference.

In summary, the building of the interference pattern needs the existence of double slits.

Role of the observer

The world of Quantum cannot be seen as it is, but it can be known with the use of instruments. There is no doubt that there is an issue with the idea that measuring interferes with the position and energy of subatomic particles. In any case, this is also referred to as the measurement problem.

Therefore, we start by seeing a strong connection between the properties of a quantum object and the way of measuring those objects in question. While people have deliberated on the realness of quantum properties, they are still yet to arrive at a proper and definite definition.

All quantum physics philosophies are mandated to lower Newtonian philosophies at a higher level ***(NB: This means that there is a continuation between Newtonian and quantum physics)*** .

The next and reasonable question goes by asking how does the role of the observer has a telling difference to the particle and wave nature of the quantum world?

One major assessment is to go back to the two-slit experiment and make an attempt to know count which slit the photon passes.

For instance, the photon is a particle; it means that it will go through one or another slit. While carrying out this experiment, it will clear the interference pattern.

CHAPTER EIGHT

Macroscopic and Microscopic World Interface

The macroscopic world is deterministic and Newtonian for local events ***(NB: You should know that the macroscopic world is not left out in its struggle from anarchy)*** .

In contrast, the microscopic quantum world radical indeterminacy reduces any assurance that relates to revealing of physical events.

Many things in the Newtonian world cannot be predicted because we can't arrive or get all the factors that affect a physical system. Meanwhile, quantum theory is not settling in that events take place regularly without any reason ***(NB: More like radioactive decay)*** .

NB: Not being able to determine the microscopic world has a lower effect on macroscopic objects.

This is because the wave function for large objects is so small compared to the large size of the macroscopic world.

The major question is that at what scale or point do the probabilistic rules of the quantum realm allow for deterministic laws that guide the macroscopic world?

The above question has pushed up into intense respite because of the new work where a NIST group placed a charged beryllium atom into a small electromagnetic cage and went ahead to cool it with a laser to its lowest energy state.

The researchers further stimulated the atom with a laser that charged its wave function. In view with the modern wave function of the atom, it was filled with a 50% probability of staying in a spin-up state in its former position.

It also had an average probability of staying in a spin-down state in a position that reaches 80 nanometers.

The outcome was that the atom was placed in two different positions, and the two different spin states, simultaneously.

The main proof that the NIST researchers had accomplished their aim resulted from their observations of an interference pattern. This means that the phenomenon is a telltale sign that one beryllium made two distinct wave functions that crossed paths with each other.

Many-Worlds Hypothesis

There are numerous opportunities and prospects moved around by quantum superpositions all over time and space.

On the other hand, Newtonian physics is a perfect description of normal and everyday experience. People still wonder how the classical world of common sense and the weird quantum world relate.

Without a doubt, the major difference happens when we observe or measure a quantum system. The why's and how's of the process is yet to be solved, and a large number of people think that new physics will not be complete until a solution has been found.

At around 1950, the continuing display of wins had made it very clear that quantum theory was corrected for only a short time.

Consequently, Many-world is known as a reformulation of quantum theory, which sees the process of measurement and observation within the wave mechanics of quantum theory and not input as extra predictions.

This hypothesis is a return to the pre-quantum and classical view of the world in which all the mathematical solutions of a physical theory are factual. In the many-worlds hypothesis, the wave equation is listened to all the time and around the world.

Like particles, quantum systems are also entangled. For example, assuming one of the systems if an observer and the outcome of the observation is to divide the observer into several copies, with every copy observing a single of the possible outcomes of measurement and not knowing the other outcomes and all other observer copies.

The link between the systems and their environments, which includes the interaction between the different observers in the world, shares the correlations that show de-coherence into non-interfering groups of the universal wavefunction.

Therefore, the whole world is spilled, faster than thought, into a multitude of jointly unobservable, rather the same real world.

A lot of many-world has stated that the likely results of a quantum conversation are known. The wavefunction does not fall when an observation is done, and it will go on evolving in a deterministic way while agreeing to all the likelihoods that are within it.

All results happen simultaneously, but it does not come in contact with each other, but each one before the world was spilled into mutually unobservable and equal real worlds.

Who developed Quantum physics?

While scientists and well-known people were taught about the technology needed to measure with the most accurate feeling, weird revelations and wonders were seen.

Max Planck is the great scientist responsible for the establishment and finding of quantum physics in today’s world. In fact, the finding of quantum physics was made with the help of Max’s 1900 paper on black-body radiation.

(Image of Max Planck)

Furthermore, quantum physics was not only founded by Max Planck. Its finding would not have yielded any meaningful thing if other scholars did not develop it.

The likes of Werner Heisenberg, Albert Einstein, Erwin Schroedinger, Richard Feynman, Niels Bohr, and Max Planck himself are credited with the development of quantum physics.

Asides from the scholars mentioned above, other important personalities were responsible for the development of quantum physics.

Another thing to note is that Albert Einstein, a great scientist in physics, did not have it easy with quantum physics.

According to reliable reports, Einstein had a challenging time with theoretical problems associated with quantum physics. Also, Albert

Einstein attempted several years to either come up with the conclusion to either invalidate the claim or change it entirely.

CHAPTER NINE

What is unique about Quantum physics?

In the territory and dimension of quantum physics, the importance of observation cannot be overemphasized. Watching and detecting something affects the physical actions that take place after that.

To further explain, light waves behave almost the same way as particles, and particles behave almost in the same way as waves, and this makes for wave-particle duality (duality here means double).

Also, the matter can move from one area to another without moving through the superseding space, also known as quantum tunneling.

Also, information is spread very fast across a wide area and across far distances. In other words, in quantum physics, we find out that the world at large is basically a chain of likelihoods.

Luckily, this assumption is disrupted when large objects are brought into play and are being questioned. This was made known by the Schrodinger's cat thought research and experimentation.

Role of Quantum physicists

Before we get started, it is important to note that Quantum Physics guides how the world operates at the scale of photons, atoms, and electrons.

The job of a Quantum physicist is to set the rules and regulations of the quantum world to look for more ways to increase their strengths.

The most noticeable and seen feature of quantum physics is that it has continued to clatter with our mindset.

Take, for example; quantum particles are also known as undulating waves because of how they act. If they have something to do with each other, it is likely to affect certain likelihoods.

CHAPTER TEN

Quantum Physics Myth

While we journey through life, there are some rules we do not take seriously. For example, if something happens, and it leads to the cause of another thing happening, it is often dependent on what occurred at the beginning.

In our everyday life, several causes lead to multiple effects. However, in quantum physics, the standard or basic rules are not the same. It is not possible to explain the simplest of things, and this includes your existence. This is because there is no certainty inherent to some properties of your system.

There is not a deterministic and predictable way to explain how your system changes after some time. You can only calculate just a set of probabilities.

Even if you try to conjure up a definite sufficient observation, interaction, or measurement, you will only notice one result: the effect you were in search of.

On the other hand, while making or going about your interaction, measurement, or observation, there are some alterations you will notice in your system.

The interpretation of this character is still not clear for almost a year. The end might not go down well with those set of people who sees it because they will be unable to interpret it.

As difficult as it may be, interpretations might be the exact thing that stops us from fully comprehending our quantum reality.

Schrodinger cat is a perfect example of this phenomenon. Let’s use it for an example if you put the cat in a box with one radioactive atom in the box.

Once the atom decays, the poison will be opened up in the box. Sadly, if the cat goes ahead to feed on it, it will die. Meanwhile, if the atom does not decay, the poison will not be released, and the cat will be safe.

This comparison caused a lot of debate, including the scientist Schrodinger. This is because of the rule of cause and effect; the car is mandated to be alive or dead. More analogies suggest that the cat died or not, the atom was decayed or not, or the poison was released or not.

On the other hand, if you did not cause an interaction, or make a measurement or observation that informs you of the result, then the atom and cat will be in a superposition of states. This means that the cat is both dead and alive at the same time.

The inability to depict whether the cat is dead or alive and claiming that it is both is purely a classical example of quantum weirdness.

A new analogy that is based on the real experiment sees firing one electron at a barrier that has two narrow slits, that is divided by just a short distance, and has a screen at the back of them.

In the real sense, the electron is supposed to pass through the right or left slit. Another real sense suggests that assuming you fire several electrons in a row, you would get two bunches as a result. One of the bunch will correspond to the electrons that passed through the right slit, while the other will pass through the left slit. Meanwhile, the stated assumption is totally wrong, as it is not what usually happens.

Here is what happens; instead, the screen will display an interference pattern. The electrons will then act like waves, and the patterns will take the form of the outcome if you fired continual light waves through a double slit.

NOTE – The above explanations are only done on single or individual electrons.

The abnormality of the Quantum is not balancing, and it confronts a perfect explanation of what it really means.

There is an approach that requires you to form an interpretation of quantum physics. The likes of the Many-worlds interpretation, the de Broglie interpretation, the Ensemble interpretation, and the Copenhagen interpretation are instances where people have made attempts to make meaning out of this analogy.

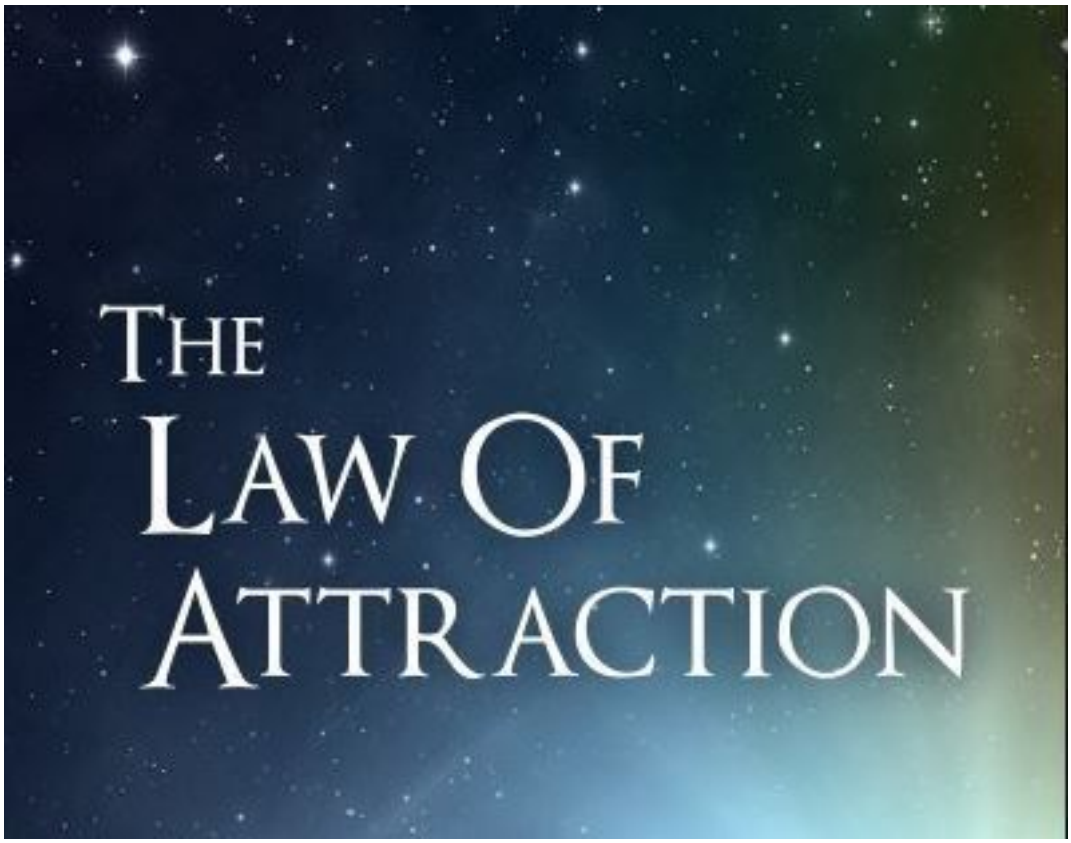
The physical theory of quantum physics is alone in its field, notwithstanding the kind of interpretation that we give to it. In simple terms, quantum physics works well as it is.

Besides, quantum physics is outstanding in some aspects because of how diverse the behavior of the quantum world is from our usual daily life experiences.

Everything we see acts as either a particle or wave, but it depends on the things you do. Like we all know, the Universe is made from indivisible quanta, and it is only possible to predict the chances of a result and not one result.

Quantum physics is non-local in both time and space, and its outcomes are seen on just the small scales. All in all, quantum physics is arguably one of the strangest things we have known the Universe to be.

Laws of Attraction



The Law of Attraction is the chance we have to bring into limelight the things we are focusing on. According to scholars, it is seen that notwithstanding our religious belief, nationality, or age, everyone is liable to the laws which guide the world as a whole, and the Law of Attraction is in no exception.

In other words, the Law of Attraction makes use of the power our mind possesses to figure out the challenging things of this world. Simply put, what we harbor in our minds will be put to reality through the Law of Attraction.

If your mind is full of positive goals, then it will be translated in a good way in your life. However, if your mind is all about negativity, then do not be surprised if everything you do turns out bad for you.

This law is the perfect reason why the Universe is an amazing place that will continue to exist. More so, the law also makes us understand that whatever we imagine or hope to get can be achieved if the right plan is put in place and if the right action backs it up.

This takes us to the question of what the Law of Attraction is all about.

The Law of Attraction is a life mystery that is yet to be unraveled. Only a small number of people fully understand the effect that the Law of Attraction has in our daily lives.

One challenging but real fact about this law is that it does not look whether we are doing our actions with our knowledge or not. All it focuses on is what we do and the things we get back in return after exhibiting one action or the other.

Regrettably, many of us close our eyes to the potential that our mind is capable of achieving. In another angle, it is very easy not to deliberate on the things that go on in our minds. Not doing so can make us carry out bad actions which we may later live to regret.

Having deliberated on the above, knowing and using the Law of Attraction to your advantage is a precious gift that is underestimated and should be celebrated.

The Law of Attraction ceases to remain a secret once the individual knows the full potential that comes with understanding and practicing it the right way.

History of Laws of Attraction

Before going deep into the bits and facts of the Law of Attraction, it is crucial you know its roots and how it can benefit you in the long run.

Subsequently, understanding the roots of the Law of Attraction can also help you in applying the law in your daily life and to the people close to you.

The facts and practices that the Law of Attraction brings have been lightning up the lives of a lot of people all through its existence.

About 100 years ago, it was believed that the immortal Buddha explained the Law of Attraction to man. Furthermore, it was also believed that the renowned Buddha desired people to believe that the Law of Attraction is that “what you are currently doing is what you have earlier imaged in life.”

The belief by Buddha is what is the Law of Attraction presents to man, and it is what man has harbored in their mind in the past century.

Meanwhile, this belief became stronger by the day, and it was spread to western culture, otherwise known as the European culture.

In western culture, this belief was then termed “Karma.” The term “Karma” is a belief that is well-known in several countries worldwide.

In the past centuries, this belief has grown among numerous people. According to the belief (karma), it is seen that what you do (whether good or bad) is what you will get in return at the end of the day.

In simple terms, it means that if someone carries out a bad action, in due time, he or she will receive the bad action in return.

For many who believe this belief, they will always feel gutted, especially when they do something bad.

On the other hand, once you have taken it upon yourself to understand the real reason and fact behind the Law of Attraction, you will have new courage in the belief that can push you to achieve great things in life.

It is important to always free your mind from negative thought because the Law of Attraction makes us understand that our mind is what makes us who we are. It also makes us believe that our mind allows us to be in control of ourselves and the world around us.

Spin-orbit coupling definition

Spin-orbit coupling is a form of effective magnetic field noticed by the spin of the electron in the rest of fame.

Depending on the belief of an effective magnetic field, there is no argument to support the notion that spin-orbit coupling has a possibility of being neutral. In this instance, non-magnetic is defined as a way of building a spin-polarized electron current.

Spin-orbit coupling in a barrier can be explored to reach efficient spin filtering. Even with the practical challenges, it is still seen that in nano-scale devices, spin current can be noticed on one end and increased on the other end.

The joint effort of the spin-orbit coupling and the tunnel barrier can be used to get to a spin transistor function. It plays a vital role in spintronics, which has a focus on spin accumulation and spin transport.

CHAPTER ELEVEN

Particles

The explicit definition of particles means a quantity of matter in usage by scientists to make theories that concern their field of study.

Also, there is no exact definition that explains what particles are. For astronomers, particles are known to be stars in the night sky. On the other hand, for physicists, particles are known as electrons.

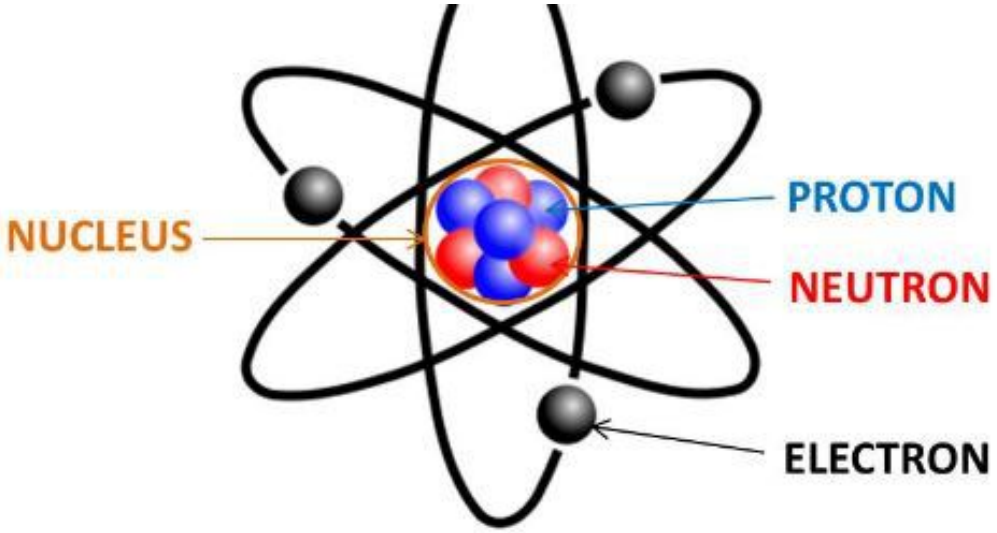
It all depends on the theory and scientific field of study under view. Think of taking a rock and breaking it with a hammer, what will be the result? The outcome of that particular action will mean that the rocks will break into smaller pieces. The rocks will continue to be broken down into smaller and smaller pieces or fragments until you can no longer see it.

The fragments that have been broken down into the smallest forms are then referred to as particles. Furthermore, physicists also see particles like fundamental fragments used by scientists to define other kinds of phenomena.

What are Atoms?

Atoms can be explained as the basic units of matter and the explaining and the basic structure of elements. Atom is known as a Greek word for

indivisible. At the earliest time, atoms were formally believed that atoms are the smallest elements in the world, and it was not able to be separated.

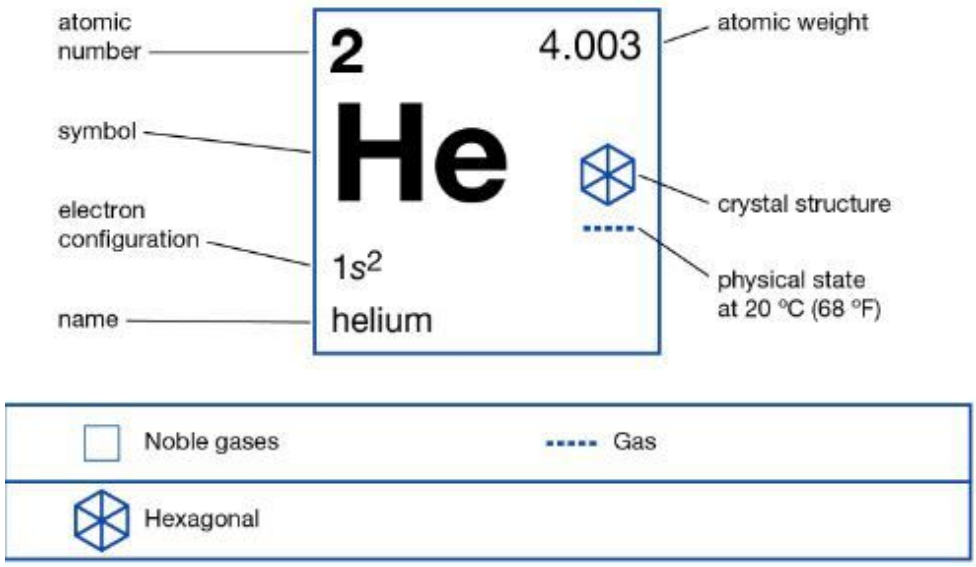


In basic terms, atoms are made of electrons, protons, and neutrons, and these are also made up of smaller particles known as quarks.

The creation of atoms was carried out about 13.7 billion years go. In the beginning, quarks met together, which led to the formation of neutrons and protons, while this formed nuclei.

The first set of atoms was originally helium and hydrogen, and it is still referred to as the most pressing element in the world.

What are Heliums?



Helium is known as the second lightest element, of which hydrogen is seen as the lightest. In basic terms, helium is a tasteless, colorless, and odorless gas that transforms into a liquid at -268.9 degrees Celsius.

The freezing and boiling points of helium are very low than other elements. Helium cannot be made to be strong by enough cooling at normal atmospheric pressure. Before helium can be solidified, you must apply a force of 25 atmospheres at a temperature of 1K ***(NB: This can also be referred to as -272 degrees Celsius)*** .

Helium was founded in the gaseous atmosphere, which was around the sun by Pierre Janssen, who was a French astronomer.

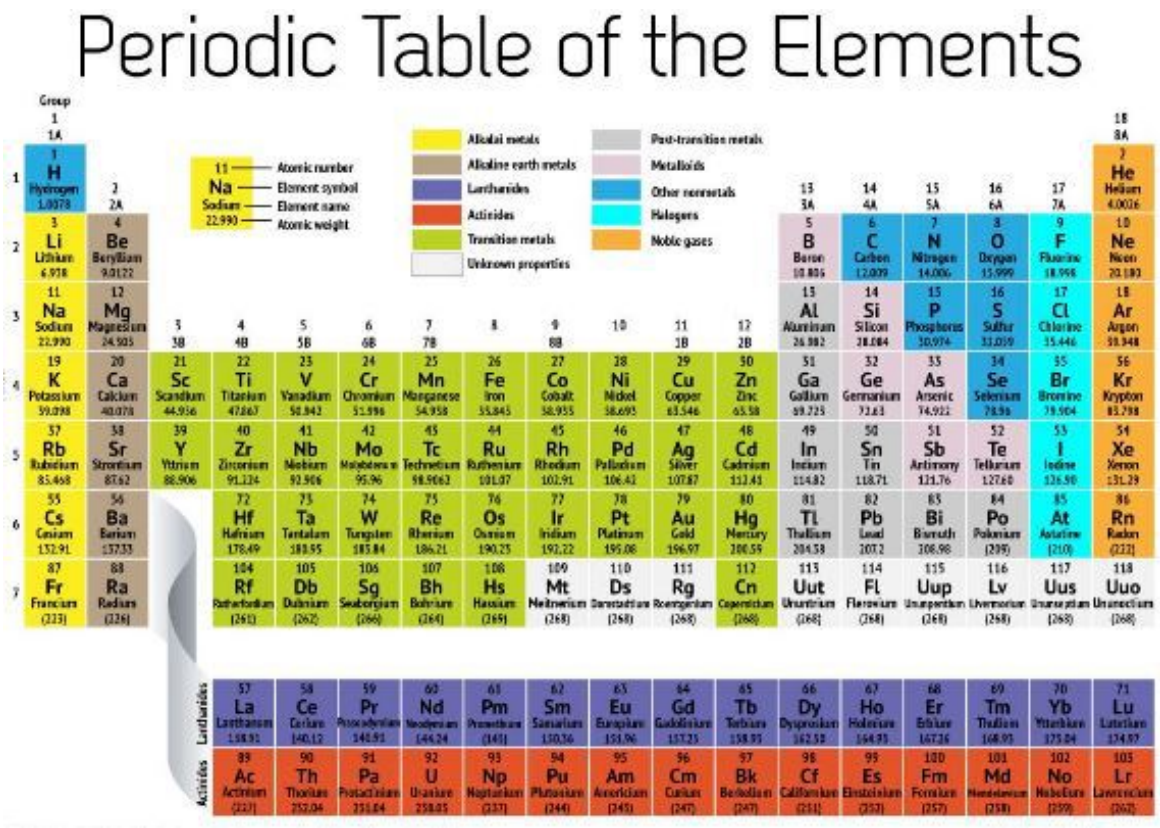
Janssen discovered a bright yellow line in the spectrum of the solar chromosphere when an eclipse occurred in the year 1868.

Helium gas, which contains 98.2% pure, is separated from the natural gas by dissolving other elements at high pressures and low temperatures.

A few heliums are taken from the dissolving of air on a large part. According to proper calculations, the amount of helium gotten from 1,000 tons of air is close to 112 cubic feet. However, this is in the measurement of normal atmospheric pressure and at room temperature.

CHAPTER TWELVE

Information on the Periodic Table



The periodic table is referred to as the arranged collection of all the chemical elements to increase the atomic number, like the total number of protons in the atomic nucleus.

Whenever the chemical elements are organized and set well, then you would notice a recurring pattern, which is referred to as the periodic law in their properties. In this group, the elements in a similar group have the same properties.

Dmitry I. Mendeleyev founded the periodic table in the mid-19th century, but that was only known as the first discovery.

Meanwhile, the discovery of the periodic table was not first known until the 2nd decade of the 20 th century.

In later years, there was a massive improvement in the definition of periodic law as the electronic structure of molecules and atoms.

The periodic law, in modern time, is shown to have a link between several elements.

Let us go down memory lane to discuss the history of the periodic law, shall we?

At the beginning of the 19th century, there saw quick development and progress in analytical chemistry. By this, we mean the art of differentiating diverse chemical substances. It also means the next development of a vast body of information on the physical and chemical properties of both compounds and elements.

The quick development of chemical knowledge later brought about classification. Connections were distinguished rapidly among the compounds more than the elements, and it resulted that the classification of elements stayed a lot of years before compounds.

Furthermore, not one general settlement was made among several chemists that relate to the classification of elements for almost 50 years. This came after the systems of classifying compounds were in use all over the Universe.

Is the Law of Attraction Real?

The worth associated with the Law of Attraction has been in existence for a long time. Also, many well-known men and women of this generation have created a legacy that has proven that the Law of Attraction is among the highest powers on this planet.

The likes of Blake, Beethoven, Emerson, Shakespeare, and Newton have all penned the Law of Attraction in their respective works while they lived.

Furthermore, in this present time, there have been a lot of supporters who have written and used the Law of Attraction in their daily living.

Some of these advocates and supporters who have used the Law of Attraction in the present time include the likes of Jim Carrey, Denzel

Washington, and Oprah Winfrey.

On Facebook alone, there about 6 million people who have penned down success stories while using the Law of Attraction.

The difficult part of conceding and admitting the fact about what the Law of Attraction brings is that all the decisions you take in life surround you alone. In the case of many people, this truth is one that they always fail to admit.

Nevertheless, the reasons why they are adamant about acknowledging that the Law of Attraction is efficient in their daily life is because they have the feeling that the law has caused a bit of issues in their life.

On the other hand, once you have discovered the ability and the changes the Law of Attraction can make in your life, then you will be rejuvenated with high hopes and courage.

All in all, you are in charge of your life, and only you have the power to dictate what goes on in your life, whether good or bad.

Is the Law of Attraction a fiction or non-fiction?

Well, the effort of Quantum Physics in the past years has greatly helped people to gain confidence in the things they do.

Also, Quantum Physics has helped people change their mindset as they journey through life by giving them rejuvenated courage to conquer the things of this world.

What’s more, the fact that scientists and great men have explored the science behind the Law of Attraction has given people a better understanding of how our mind plays a significant role in our living and the world as a whole.

It is not compulsory if you fail to comprehend what the relationship between the Law of Attraction and Quantum Physics is. The most important thing to understand is that our mind plays a major role in what we do daily.

Furthermore, the fact that we may fail to comprehend the relationship between the Law of Attraction and Quantum Physics does not mean that we

should not appreciate and relish the advantages that the law presents.

As time goes on, scientists will continue to unravel more mysteries and information that the law offers. If they can do that in the best way, then people will relish the new realization that with our mind, we can control what is around us without having to depend on the directions of others.

There is no need to be bitter because the world is at our beck and call, and with our mind, virtually everything is possible or can be attained.

If you devote extended time to know how the Law of Attraction works, your life will be more fulfilling. Your mind does not have any restraint and limit, and with the Universe at your side, you can always get to enjoy the benefits of life.

CHAPTER THIRTEEN

How to use the Law of Attraction

If we can comprehend the astonishing likelihood and opportunities that life presents to us, then we would know that we can assume the role of artists.

In other words, we can form images of the life we want and also decide on the things that we have foreseen.

If we do not cherish or like the image we have pictured, we are expected to change its looks.

In life, it is said that we are in charge, and we determine what kind of picture we create and make.

There is no difficulty associated with using the Law of Attraction. The law does not create any form of confusion; rather, it opens our minds and allows us to picture the right things.

Furthermore, every law of nature, including the Law of Attraction, has no mistake in it at all.

What you plan to achieve or meet something in life, if you stick to a plan and work hard towards it, then the achievement is only a matter of time.

In simple terms, you can easily achieve what you have set out to achieve if only you have the determination, drive, and the right plan to go with it.

The truth about the Law of Attraction

The law of attraction is a belief that has people with the thought that the Universe or the world provides certain things for you.

According to many people, they believe that the law is a universal one that governs or guides everyone.

Furthermore, they also believe that the outcome of good things is a result of good actions, while the outcome of bad things is a result of bad actions.

On the other hand, the law of attraction goes way beyond the above explanation or assumption. While some people believe in the law, others are

not blinded or easily deceived by the law.

In this section, we will discuss several reasons why it is generally seen that the law of attraction does not exist.

Here they are:

- **Absence of purpose**

Wealth and material things that can be bought with riches are the most essential and crucial exhibitions that attract beings. It is believed that the Universe sets your purpose in life and not you.

In fact, you are only allowed to select and dream of the kind of goals you want and not value. Thus, it makes people not have enough passion for the things they are doing, but only what they want.

- **Absence of action**

You can only bring your thoughts into good if you act and live as if you have reached your goal. A law of attraction expert identified as Esther Hicks said that “Individuals didn’t come into the surroundings to create based on action.”

The reason for action is to display to the Universe that you are aware you do not possess it all, and you are not sure that it will work for you.

It is much certain to a lot of people that action is important to achieve your desired goal. However, for others, it is not compulsory when the law of attraction is brought to the table.

- **Absence of plan**

Assuming I have the belief that the only way to achieve my goal is to live as if I had already achieved them, then I see no need to fight or push forward in trying to achieve them anymore.

If you make plans, it will show the world that you are not sure, or you do not believe you are going to achieve your goal.

Having doubt is a negative thought which will make for more negativity. Consequently, being negative will also set you on your way to failure

instead of success.

- **Absence of date**

If, as a human being, you are living as if you have already attained your goal, then there is no reason why you need to set deadlines for achieving them anymore.

Meanwhile, there is no doubt that setting deadlines help in achieving one's goal. However, experts in the law of attraction believe that it would not be right to set a deadline for the Universe to help you attain your goal.

What then happens if the deadline has passed and you are yet to attain your goal? Would you go about lamenting and weeping? Certainly no.

So, it is essential not to attribute your success to a deadline when the Universe is allowed to run.

- **Absence of challenges**

According to the law of attraction experts, it is believed that challenges are negative thoughts that are not meant to be harbored in our minds.

Moreover, if you are quite sure you have attained your goal in real life, then there is no need for any challenge of any sort.

Esther Hicks also had this to say, “When you have known that thinking of the things you do not need only draws the things you do not need into your thoughts, and then controlling what goes on in your mind will not be challenging.”

Also, there are a lot of goals you can set and which challenges may also come into play. Sadly, there is a belief in the law of attraction that does not permit you to achieve this.

- **Absence of compassion**

This assumption means you should not interfere with anything on the bad side, such as helping the less privileged or giving to charity.

According to this assumption, doing all those will attract or draw you closer to poverty and negativity. Wallace Wattles once said that people should not discuss poverty, have anything to do with it, or even find out what brought about poverty.

Also, he made it clear that people should not use their time in helping the charity or visiting the disabled because it only attracts us to the poverty state they are in.

Instead, Wallace Wattles made it clear that we should associate ourselves with riches and get in contact with those that have wealth.

Furthermore, the law of attraction forbids that people who believe in it should engage in professions, which include being a nurse, physician, police officer, psychologist, paramedic, and also a clergyman.

The law also disapproves that people who believe in it should have business with poor people like being a banker, accountant, lawyer, or mortgage broker.

- **Absence of support**

The absence of support is also linked with the law of attraction. Believers of this law have the notion that you will attract what you are thinking about. So, for believers of the law of attraction, they are meant to avoid or stay away from any support groups for people who are down physically or people with mental illness.

Research suggests that believers of this law should desist from alcoholics, fat, or people with breast cancer because it is only due to worsening your problems.

- **Lack of mind**

To practice the law of attraction fully, you must have an unreal mind. This means that you must live as if the world was not in existence until you have finally achieved your goals.

Living in this manner means that you believe in the Universe, and you know what the Universe is capable of achieving for you. Harboring actions,

challenges, and plans in your minds will only set you in the path of failure.

Instead of focusing on all that, simply have a free mind and focus on the outcome. By this, you have clearly defined the proper meaning of not having a mind.

If you know or if you show concern for the things around you, it means that you are mindful. However, the law of attraction needs you not to have a mind until you have attained success.

- **Blame you**

Being positive will always attract more positivity. The result of this assumption is that you are responsible for anything that happens within yourself. For instance, you are fully responsible for your achieved or failed goal.

It does not matter whether the goal can be attained or not; it still does not take the fact that you are to blame yourself if you cannot attain a certain height you have set.

Additionally, you are not left with only the control of your actions and thoughts; you are also responsible for the things that happen around you.

- **Fault the victim**

The only way bad things are likely to happen to you is if you have thought that bad things will happen to you.

So, in this law, it is believed that you will only reap the things that you have thought about. Whenever anything bad happens to someone, they are fully responsible for that particular bad circumstance.

This law also forbids that you have compassion for anyone suffering in hunger or pain because they brought hunger and pain upon themselves.

Experts in this field believe that if your thoughts are good, nothing bad can happen to you. Suffering or negativity, as I said earlier, is as a result of the negative thoughts you have imagined.

- **We are not perfect**

The law of attraction is perfect, and its believers are also expected to have a perfect life. According to several researchers, it is often said that every goal is attainable only if you can think and believe it will happen. Categorically speaking, there is nothing such as an unrealistic goal.

With only your thoughts and imagination, you can think of having a perfect life, good health, wealth, right weight and body size, and so on, and you will have them all.

On the other hand, based on reality, life is far from being perfect. Life to you can be exceptional, incredible, and amazing, but it can never be perfect. This is because everyone in the world is faced with their problem, which is always hidden from you.

Why are we so sure that perfection is not possible? Or why do we think that this thinking is wrong? Well, thinking and pushing to achieve perfection makes one feel like they are in the right direction, but it is only for a short period. Thinking and pushing forward in life reduces your chances of achieving your goal with being happy and blaming others.

While in search of perfect health, perfect job, perfect life, perfect family, perfect house, and perfect friends, and so on, you will only end up in total disappointment. Life and the Universe is not a bed of rosary as even the richest of men in the Universe also have their problems, and life is far from perfect for them.

CONCLUSION

There is no better way to conclude quantum physics by saying that the concept is the new way of life. Since the 19th and 20th century when quantum physics came into limelight, it has continued to cause a bit of argument among many.

However, in recent times, the air has been cleared to what the concept really represents people in the Universe.

Quantum physics is the area of physics that explains or break in simple terms how everything in the Universe works.

The concept is linked to biology and chemistry while explaining how both work. Furthermore, Quantum physics also explains how atoms work, how a computer chip works, how photons of light are transformed into electrical current, and many more.

All in all, quantum physics tells us a lot about our reality and why things work the way they are .